MTFC Scenario Quest Response 2025-26

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MTFC Scenario Quest Template Use Notes:

- *Refer to the official MTFC Scenario Quest 2025-26 for the 30 prompts and scoring instructions.*
- *The use of this template is OPTIONAL.*
    - *It is provided as an optional resource for teams to keep their Scenario Quest response organized. Teams who wish to use this template should make a copy in order to edit.*
- *The final version of the team's MTFC Scenario Quest Response should be downloaded as a PDF or Word document to submit on the ICS Dashboard. A single file will be submitted.*
- *Additional resources (including the Actuarial Process Guide) can be found on the Modeling the Future Challenge website: https://www.mtfchallenge.org/resources/*
- *Please direct any questions to challenge@mtfchallenge.org.*

Part 1: Project Definition *(Corn Farming Topic Prompts)*

These prompts can be found on page 6 of the 2025-26 Scenario Quest. Additional information on Project Definition can be found in ***Step 1: Project Definition*** in the Actuarial Process Guide.

Team Responses:

#1: Who is at risk?

In 3-5 sentences, describe what groups (besides Farmer Jones herself), might be at risk of loss in regards to farming corn? Identifying the scope (boundaries on size) and scale (potential severity or impact) that the risks have is important for understanding what needs to be characterized. Identify 2-3 other groups at different levels (e.g., local, state, national, and international levels) within your response who may have a loss related to corn crops.

- Response:

Grocery stores and consumers are also at risk if there is a shortage of corn. The scope of this issue depends on the frequency of severe weather in other areas, with the impact increasing based on the weather for farmers. The scale can also differentiate between farmers, some losing minimal crops while others lose entire farms and large amounts of property damage.

Not only is corn eaten by humans, but it can also be used to feed livestock and may even serve as a key component in industrial and household products. This indicates a widespread impact due to the loss of corn across the affected area. This area can range from local to even international, all dependent on how significant the severe weather is and where it hits.

#2: Defining the risks

In 3-5 sentences, describe the risk to Farmer Jones and her farm itself. What kind of quantified values can you identify that could be valuable numerical ways of characterizing the risks of crop loss? You may refer to the available datasets and prompts for ideas, but also consider what kind of data or numbers you would think would be the most helpful (even if that data does not exist in the provided datasets–sometimes you have to dream about what data you would like to find to drive you to fruitful data searches in your own project).

- Response: **Farmer Jones and her farm have to worry about natural disasters, weather, as well as property damage. Natural disasters and weather can be quantified using past weather reports, and seeing the frequency and severity of different events. To see a general trend in losses, we could gather data on the farmer's past gains and losses and try to understand why each thing occurred. Property damage can be measured using data given by farmers on how many things and the price of them they had to pay over a couple of years for repairs.**

#3: Identify Risk mitigation strategies

In 3-5 sentences, identify a risk mitigation strategy that Farmer Jones may choose to mitigate risk for her farm in each of the three categories and describe how you think each of these three strategies might be able to help mitigate those losses. Is there a strategy category that seems to be more or less feasible than another category to pursue? No calculations needed.

- Response:
    - **Insurance**
    - **Indemnity payments**
    - **Farm buildings and structures (barns, sheds)**
    - **Equipment, tools, and machinery**
    - **Harvested crops and supplies**
    - **Specialized property, like irrigation systems or greenhouses**
    - **On-premises liability (e.g., a visitor gets injured)**
    - **Farm product liability (e.g., someone gets sick from a product you sold)**
    - **Coverage for legal defense costs**
    - **Indemnity payments: If a covered event causes a loss, the farmer receives an indemnity payment to compensate for the difference between the insured amount and the actual outcome.**
    -

Part 2: Data Identification & Assessment *(Corn Farming Topic Prompts)*

These prompts can be found on pages 7-9 of the 2025-26 Scenario Quest. Additional information on Data Identification and Assessment can be found in ***Step 2: Data Identification & Assessment*** in the Actuarial Process Guide.

Team Responses:

#4: Identifying the type of data

In 2-3 sentences each, identify which of the three categories of data identified in the Actuarial Process Guide are provided in each of the tabs of the scenario's attached dataset. Be specific in identifying the column (or description) from the dataset or the scenario description in your response. Explain (at a high level) what information and insights these datasets can provide.

1. Cause of Loss Smith Co tab

This tab gives us the reasons why crops were lost every year, how much farmers had to pay an insurance company, and how much the company paid them back. This data can be used to categorize risks and outcomes because it tells us what the causes of loss are. It tells us the severity of potential losses because it tells us how much the insurance paid back for the damages. It can also tell us historical frequency because we can find out which causes happen the most in certain months.

2. Corn Planting Costs tab

This tab shows the costs of planting corn per acre and how many bushels of corn they expect to grow per acre. This data can be used to find the severity of potential losses because it tells us how much the farmers have to pay and how much they would lose if they can't resell corn.

3. Corn Harvest Costs tab

This tab shows the average corn prices per month. It can help find the severity of potential losses because, depending on when a farmer lost corn to sell, they might have lost valuable time to sell corn for a high price.

#5: Planting Costs for Farmer Jones

What is the average total cost per acre for corn production (2016-2025) and average total cost per bushel (2016-2025)?

- Response: **$548.11/acre, $3.07/bushel**

#6: Assumed yield for Farmer Jones

What is the average assumed yield (bushels per acre) for 2016-2025?

- Response: **178.5 bushels/acre**

#7: Anticipated total planting costs

For Farmer Jones, if all 345 of her farm's acres are planted, using the average cost per acre found above in #5, what is the anticipated total cost for planting in the next season?

- Response: **$189,097.95**

#8: Range for anticipated costs

Critical Thinking: Realistically, is this value found in #7 higher, lower, or "about right" for the actual anticipated costs? What might be a realistic "range" (i.e., reasonable minimum and maximum values for the planting costs)? Why? Explain in 1-2 sentences (additional computations are optional).

- Response: **This cost is likely lower than what it should be, as it was calculated using the average operational costs from 2016 to 2025. However, this average is not representative of what the costs would be for 2026, as the prices tend to increase as time goes on, meaning the real price would be higher.**

#9: Harvest Expectations for Farmer Jones

For Farmer Jones, if all 345 acres of her farm are harvested with the average yield found above in #6, what is the projected total yield (in bushels)?

- Response: **61,582.5 bushels**

#10: corn sale prices expectations

Find the average cash corn prices for each individual month (Jan - Dec) for 2016-2025 and note them in a table (shown below).

- Response:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
$4.35	$4.43	$4.47	$4.55	$4.65	$4.73	$4.66	$4.46	$4.34	$4.21	$4.20	$4.35

#11: Trends In Corn Prices

Identify 2-3 trend(s) that you notice regarding cash corn prices (i.e., over the years, within a calendar year, or within a marketing year) in the Corn Harvest Prices tab that may impact when a farmer wishes to sell their crop. Explain why you believe the trend is noteworthy or why it occurs in 1-2 sentences each (no new computations required).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2017	$3.34	$3.39	$3.43	$3.34	$3.39	$3.35	$3.40	$3.19	$3.21	$3.23	$3.14	$3.20
2018	$3.24	$3.33	$3.43	$3.52	$3.57	$3.54	$3.41	$3.27	$3.29	$3.40	$3.40	$3.52
2019	$3.52	$3.54	$3.57	$3.51	$3.59	$3.95	$4.11	$3.91	$3.72	$3.79	$3.64	$3.70
2020	$3.78	$3.74	$3.64	$3.28	$3.12	$3.11	$3.14	$3.08	$3.39	$3.61	$3.82	$4.05
2021	$4.40	$4.87	$4.89	$5.35	$6.03	$6.19	$6.22	$6.38	$5.63	$5.02	$5.23	$4.05
2022	$5.70	$6.11	$6.59	$7.12	$7.34	$7.48	$7.44	$7.40	$7.42	$6.53	$6.50	$6.69
2023	$6.74	$6.83	$6.70	$6.75	$6.57	$6.57	$6.33	$5.77	$5.22	$4.96	$4.74	$4.89
2024	$4.84	$4.39	$4.43	$4.50	$4.63	$4.60	$4.32	$4.02	$4.09	$4.01	$4.12	$4.27
2025	$4.37	$4.59	$4.53	$4.64	NA	NA	NA	NA	NA	NA	NA	NA

- Response:

As seen in the heat map, corn prices are usually the highest from Apr to July, with the only exception being 2020. This means that farmers should sell corn from the spring to the summer months. This could occur because Americans would buy more corn in the summer and spring for BBQs and cookouts.

#12: Harvest Expectations with October sale

If Farmer Jones harvests and sells her entire harvest (found in #9) using the 2016-2025 average corn sale price for October (as found above in #10), what would her revenue be? What would her profit be (using planting costs found in #7)?

- Response: **Her revenue would be $259,262.33 if she sold her harvest in October. Her profit would be $70,164.38.**

#13: Harvest expectations with optimal sale

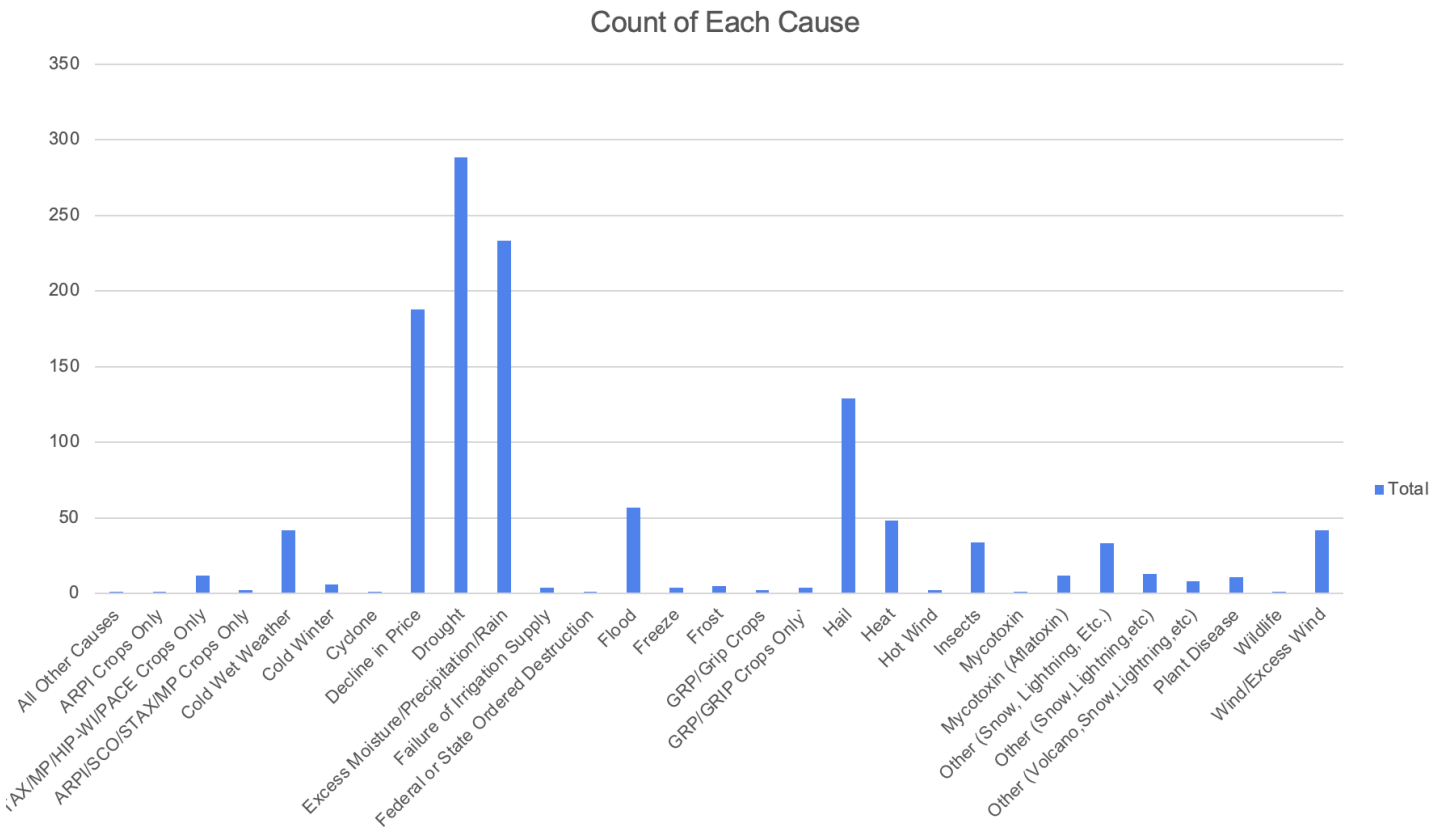
If Farmer Jones is able to store her harvested corn and wait for the optimal sale, (using the 2016-2025 averages found in #10), what could she anticipate for a maximum revenue? Identify the month and revenue amount.

- Response: **She could anticipate a maximum revenue of $291,285.23 if she sold in June.**

#14: Creation of a data visual.

Create a chart (e.g., pie chart, bar chart, etc.) that summarizes, labels, and categorizes the causes of loss for claims for 1994-2024. Include the chart in your response.

- Response:



#15: Top causes of loss & their impacts

Based on the data visual you created, what appear to be the top 3 leading causes for a loss claim? Why? Explain in 1-2 sentences (include the frequency of these claims in your response).
How does this information on the top 3 causes of loss inform Farmer Jones as she plans for future risks to her farm in Smith County? Explain in 2-3 sentences.

- Response:

The three top causes for loss in the data set is a decline in price, droughts, or excess moisture, precipitation, or rain. This is because the count of those loss claims is the greatest with all three having above well 150 claims. This means that Farmer Jones should prioritize ways to minimize these risks in particular. The most important should be placed on minimizing the effects of drought, closely followed by the effects of excess moisture, precipitation, and rain, and then finally finding a way to fight against the price decline.

Part 3: Mathematical Modeling *(Corn Farming Topic Prompts)*

These prompts can be found on page 10-11 of the 2025-26 Scenario Quest. Additional information on Mathematical Modeling can be found in ***Step 3: Mathematical Modeling*** in the Actuarial Process Guide.

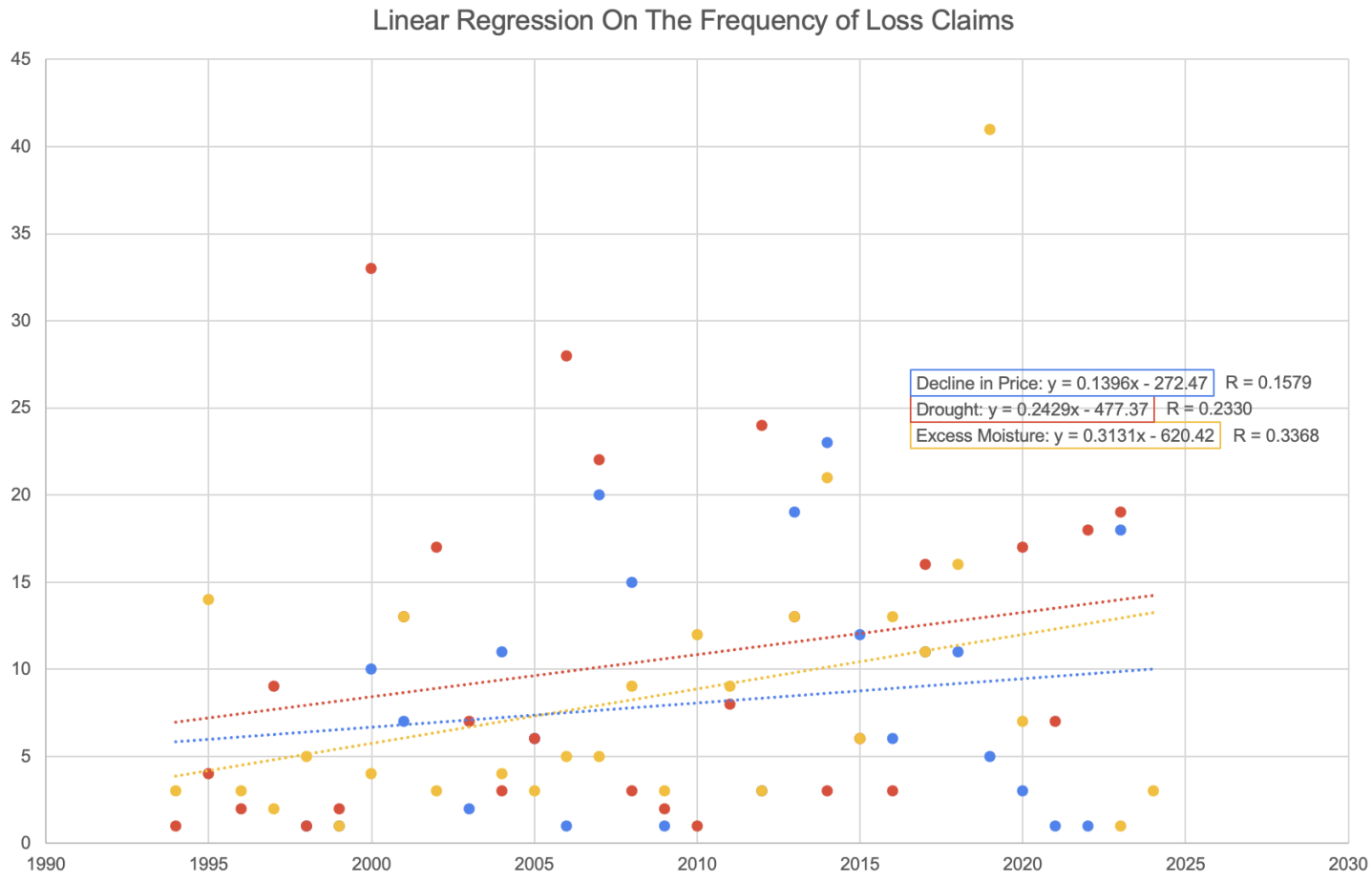
Team Responses:

USE THE USE THE CAUSE OF LOSS TAB TO ANSWER #16 & 17

#16: Linear regression

Conduct a linear regression on the frequency of loss claims for the top 3 cause of loss claims identified in prompt #15 for 1994-2024. Provide the plot (plot all 3 on the same chart), regression equations, and correlation coefficients in your response.

- Response:



#17: Cause of loss trends or patterns

Referring to your regression conducted above in #16, describe 2-3 trends or patterns you observe in causes of loss over the historical timeframe (e.g., maximums, minimums, patterns, co-occurrence of causes of loss, etc.). Offer a short plausible explanation for why you believe the trend occurs (1-2 sentences each).

- Response:

- **The frequency of loss claims has increased as time has gone on. This indicates that environmental fluctuations and disasters occur with a greater frequency and severity.**
- **Most years have fewer than 10 claims. This implies that there are other factors than the simple presence of disasters that play into how much damage is sustained.**
- **Drought and excess moisture seemingly have an opposite loss claim frequency; when there is a high amount of claims for drought there is a low amount of claims for excess moisture, and vice versa. This is because drought means "a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage," which is the opposite of excess moisture.**
- **There seemed to have been a terrible drought in 2000 and a lot of excess moisture in 2018. The amount of loss claims for those events recorded in those years are much higher than the previous or subsequent years.**

#18: Assumption evaluation

In 1-2 sentences, evaluate and assess the reasonableness and rational basis for the assumption below. Note why the assumption is necessary or reasonable to simplify the topic in order to model or if the assumption goes beyond what is reasonable.

Assumption: "Nationally, approximately 91% of farm producers have farm insurance. We assume that the rate of farm producers who have farm insurance is the same for Smith County, Iowa."

- Response: **This assumption is a little overstepping, as it takes a national statistic and uses it for a statistic for one small town. It might be necessary because the data for the one town itself is not there, so assumptions will have to be made in order for the project to work. If more data for the state or even the town can be found, then use that, but for now, that assumption must be assumed to be true.**

#19: Assumption development

Write your own 1-2 sentence assumption that would pertain to this real-world scenario for math model creation (it may be an assumption about the scenario's data, problem statement, possible outcomes, math model structure, or other pertinent factor). Provide a 1-2 sentence justification explanation as to why the assumption is needed and reasonable.

See the 1-page Resource on Assumption Development in Step 3: Math Modeling in the MTFC Resource Library for more details and examples on Assumption Development.

- Response: **From 2011 to 2024, insurance company plan names were tracked, showing that RP insurance is used by 83.4% of farmers in Smith County. We assume that this distribution of insurance companies stays the same from 2010 to 1994, meaning that from 2024 to 1994 RP was used by 83.4%.**

#20: Frequency of claims due to drought

From the Cause of Loss tab (1994-2024), what is the annual average frequency of claims made for drought for farmers in Smith County, Iowa?

- Response: **There are on average 10.286 claims made for drought for farmers in Smith County, Iowa annually.**

#21: Expected value of loss due to drought

For Farmer Jones, what is the expected value of crop loss due to drought in a given year (based only on the actual cost for Farmer Jones to plant)? Refer to the planting costs found in #7 for Farmer Jones' severity of loss.

For more information on expected value, see the 1-page Resource on Expected Value in Step 3: Math Modeling of the MTFC Resource Library.

Cost: $189,097.95
Probability: 26.91%

- Response: **The expected value of loss is $50,886.26 due to drought in a given year.**

#22: Average annual insurance payout due to drought

What is the average annual insurance payout per policy for farmers in Smith County due to drought (use the Cause of Loss tab)? What could this mean for Farmer Jones as she considers her risks due to drought? Explain in 2-3 sentences.

- Response: **The average annual insurance payout due to drought is $14,012.76. This means that Farmer Jones can expect to have at least $14,012.76 of losses due to drought, and thus her insurance policy should cover at least that much.**

Part 4: Risk Analysis *(Corn Farming Topic Prompts)*

These prompts can be found on page 12-13 of the 2025-26 Scenario Quest. Additional information on conducting a Risk Analysis can be found in ***Step 4: Risk Analysis*** in the Actuarial Process Guide.

Team Responses:

#23: Risk mitigation strategy: Grain Silo

Farmer Jones is considering purchasing and installing a grain silo to store harvested corn for long periods of time. She is considering a 100,000 bushel grain storage silo that would cost $250,000 to purchase and install (labor included).

1. What risk(s) might Farmer Jones mitigate by installing a grain silo? What kind of risk mitigation strategy is this (behavior change, modifying the outcomes, insurance)? Explain in 1-2 sentences.
2. Identify 2-3 advantages or "pros" of installing a grain silo as a risk mitigation strategy. Explain and justify your response in 2-3 sentences (no new computations necessary).
3. Identify 2-3 disadvantages or "cons" to installing a grain silo as a risk mitigation strategy. Explain and justify your response in 2-3 sentences (no new computations necessary).

- Response:
    1. **Farmer Jounes, in installing a grain silo, would mitigate the risk posed by excess moisture, as it would ensure the crops are stored in the proper conditions. The same goes for flooding.**
    2.
        a. **Pros:**
            i. **Mitigates risks caused by flooding**
            ii. **Mitigates risks caused by high humidity**
            iii. **Mitigates risks caused by hail**
    3.
        a. **Cons:**
            i. **May increase the expected value of damages if damaged**
            ii. **May not increase expected profit by mitigating those risks**
            iii. **Susceptible to cyclone damage (requires maintenance)**

#24: Risk mitigation Strategy: irrigation system

Based on the fact that drought seems to be a major cause of loss, Farmer Jones is exploring the option to install an irrigation system for her entire farm. Details for the system she is exploring are included below. For this scenario, we assume that she has ample groundwater access for the pumps and does not have to purchase water access rights.

1. Installation Cost: The system would require pumps and permanent piping, which is anticipated to be $1,500 per acre for labor and materials.
2. Usage Cost: Once installed, per-acre pumping costs are projected to be $58 per acre for energy usage for the season and an additional $30 per acre per season for maintenance and repairs.
3. Projected impact: Based on conversations with neighboring farmers who have installed irrigation systems on their corn farms also in Smith county, it is projected that Farmer Jones could anticipate a yield of 270 bushels of corn per acre by using the irrigation system.

Questions:

1. Identify the installation costs and annual operating costs of the irrigation system for Farmer Jones' farm.
2. What is the anticipated annual corn harvest yield (in bushels) with the irrigation system?
3. If Farmer Jones were to sell her entire crop upon harvesting in October, what is the anticipated revenue for this anticipated harvest with the irrigation system (use the 2016-2025 average corn sale price for October as found above in #10)?

- Response: **The total installation costs will be $517,500, and the annual operation costs will be $30,360. Her anticipated corn harvest yield with the irrigation system is 93,150 bushels. The total anticipated revenue if sold in October is $392,161.5**

For Questions 25-26:

The U.S. Department of Agriculture's Risk Management Agency offers a variety of insurance plans available for specific commodities, including corn. Farmer Jones is considering purchasing a Revenue Protection crop insurance policy. This type of policy would provide a guarantee against the undesirable outcome in which anticipated crop yields are lower than projected (due to natural causes) as well as a guarantee against the undesirable outcome in which the sale price at harvest is lower than projected sale price when the policy was purchased earlier in the year (thus protecting against a drop in revenue). Several types of insurance policies exist and the premium (payments that the farmer would need to make to the insurance company) would be cheaper or more expensive depending on what is included in the coverage of the policy.

Equations

1. Guarantee per acre = (projected yield) x (coverage percentage) x (higher of projected or harvest price)
2. Actual Revenue per acre = (actual yield) x harvest price
3. Insurance Payout (only triggered if the guarantee is greater than the actual) = guarantee per acre – actual revenue per acre

Conditions Farmer Jones is Considering for a Scenario Outlining a Decline in Price

1. Farmer Jones is considering a policy with 85% coverage that has a premium cost of $25 per acre.
2. For the scenario that Farmer Jones is considering:
    a. the approved yield is the same as the actual yield (computed by you in #6),
    b. the agreed-upon projected price is $5.20 per bushel of corn, and
    c. at harvest, the actual price was $4.39 per bushel of corn.

#25: Characterizing the crop insurance scenario

Using the equations and conditions outlined above:

1. Find the revenue "guarantee per acre" with 85% coverage.
2. Find the "actual revenue per acre."
3. Use the values found above. If the insurance payout is triggered, compute the insurance payout per acre and total insurance payout. If the insurance payment is not triggered, explain why not (in 1-2 sentences).

- Response:
    - **1. The guarantee per acre with 85% coverage is $272,195**

- **2. The actual revenue per acre is $270,347**
- **3. The total insurance payout is $1,848 and is $5.36 per acre.**

#26: Value of the insurance policy

While Revenue Protection can address the risk of lower yields than anticipated, Farmer Jones is specifically interested in exploring how Revenue Protection can be used to mitigate the risk of a drop in price (if she was only interested in mitigating risk of lower yields, she could purchase the cheaper Yield Protection insurance).

1. Identify the total cost of the annual premium for Farmer Jones' farm for the Revenue Protection plan outlined above.
2. Based on the analysis conducted here on Revenue Protection, would you recommend that Farmer Jones purchase revenue protection crop insurance to protect against a drop in price or potentially rely on Yield Protection insurance only? Why or why not? Explain in 2-3 sentences (additional computations optional).

- Response:

1. **The annual premium is $8,625 for the 345 acres every year.**
2. **No, we would not recommend Farmer Jones to use the Revenue Protection plan. This is because they would be paying around $8,625, while the average payout every year would be around $1,848. This means that on average, Farmer Jones will be losing $6,777 every year, or about $19.64 every acre. The only reason Farmer Jones should choose this plan is if their land is especially risk adverse or sees more large and frequent price declines. In any other case, Farmer Jones should choose a different plan.**

Part 5: Recommendations *(Corn Farming Topic Prompts)*

These prompts can be found on page 14 of the 2025-26 Scenario Quest. Additional information on making Recommendations can be found in ***Step 5: Recommendations*** in the Actuarial Process Guide.

Team Responses:

#27: Irrigation system impact

Based on the data available to Farmer Jones, other corn farmers in Smith County who have installed an irrigation system like the one she is considering have found that their chance of loss due to drought has dropped to 0.2% in any given year.

If Farmer Jones installs the irrigation system as outlined in Prompt #24 above, what is her expected value of loss due to drought (with severity of loss being the cost of planting found in #7)?

- Response: **Total cost of planting: $189,097.95, Total cost of installation: $517,500, Annual operation costs will be $30,360. So the expected value of loss is 0.002*(189,097.95) or $378.19.**

#28: Comparison of expected value of loss

Compare the expected value of loss with the irrigation mitigation strategy (what you just found in #27 above) to the expected value of loss without mitigation measures that you computed in #21. Is this expected value of loss a noteworthy improvement or not? Explain in 1-2 sentences and justify your answer with relevant supporting computations.

- Response: **Expected value of loss without mitigation measures $50,886.26, while with irrigation is $378.19. It is definitely a noteworthy improvement. This is basically a complete elimination of the expected financial loss. At the same time, though, there is still a hefty first-time payment to implement the system as well as around $30,360 of operating costs every year.**

#29: Profit trajectory with irrigation

What is the anticipated profit for the first year after utilizing the described irrigation system (assuming the planting costs as found in #7)? What implication does this have for a timeframe projection of profitability with an irrigation system? Explain and justify your response in 3-5 sentences with any supporting computations necessary.

- Response: **Total cost: $189,097.95 + $30,360 + $517,500 = $737,057.95. Total profit: 93,150 Bushels * $4.45 average sale price =$ 414,517.5. The profit for the first year will be $414,517.5 - $737,057.95 = $-322,540.45. The profit for the second year will be $414,517.5 - $219,457.95 = $195,059.55. This means that while there will be a loss in the first year, after the next two years, farmer Jones will make back the money and start gaining a profit of $195,059.55 per year.**

#30: Should the irrigation system be recommended?

Identify 1-2 advantages or compelling reasons to install the irrigation system and 1-2 drawbacks or possible

consequences of installing the irrigation system.

Based on your analysis, would you recommend that Farmer Jones invest in the irrigation system for her farm? Why or why not? Explain in 3-5 sentences and justify with any relevant computations and values.

- Response:
    - **Advantages:**
        - **Much cheaper annual expected value of loss**
        - **Will make money back over time**
    - **Disadvantages:**
        - **Hefty initial payment, which means that the irrigation system needs to be kept for many years.**
    - **We would recommend that Farmer Jones invest in the irrigation system for their farm because ultimately they would save significantly more money and make back their losses in a relatively short period of time. After making back the money, they would start making an annual profit of $195,059.55, which is $124,895.17 more than the annual profit without the irrigation system. Also, it would also only take two years to get to this point so she makes her money back very quickly.**